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Dear Mr. Wai-Sing Louie,

This is our response to your comments on our patent application #10/764,168 filed on 5.3.05, in which you rejected all our claims. Below, we describe our vision and analysis of our invention in reference to Nakamoto's patent # 6891320, wherein we will try to convince you that our invention is unique and does not infringe by any means on his patent.

Let me start from your **objections** first, in which you questioned carbon nanotube firmness. In fact, the nanotubes are extremely strong and resilient filaments and will never bend under their weight even for the length exceeding 10-20 μm, far longer than we use in the presented structures. Furthermore, the nanotubes are by far mechanically stronger than steel filaments of similar dimensions, and are currently used for making nanotube ropes with the highest mechanical strength ever.

Let us move now to the **rejection** part. As an introduction, before analyzing in details all your rejections, let us make one overall statement, regarding the key difference of our design with respect to Nakamoto's one, which is applicable to all our devices disclosed. The key factor is that the cathode and anode electrodes in our designs **are not coplanar**: cathode plane is elevated above the anode plane by placing an insulator layer underneath the cathode pads (claims 1-13) or anode plane is elevated by the insulator layer over the cathode plane (claims 14-21). In all these cases, the dielectric thickness determines the anode-to-cathode distance which can be made as short as 0.1-0.2 μm for the devices of claims 1-13 or can be adjusted to the nanotube length for the devices of claims 14-21. This implies extremely low threshold voltage for the electron emission. All electron emission events occur between two top surface planes, and electrons move essentially in the normal to the substrate direction. In other words, we utilize a lateral placement of electrodes, while the current path is vertical.

The Nakamoto's design is completely different and relies on a **coplanar** approach. Unlike our design, his device is really "of lateral type". He uses side planes (22a and 24a, see Fig.3 of his patent) normal to the substrate plane as major cathode-to anode planes, and the active gap is controlled by the distance between them. Electrons in this case fly essentially parallel to the substrate, while the active gap distance (1-30μm, col. 4, line 23) is formed by a photolithography. In this design, since the nanotubes must have some length to perform, typically 1μm or more, the resultant distance must be at least 2μm or larger to prevent device electrical shorts, i.e. ~ order of magnitude larger than in our case. If any of the nanotubes "protrudes into the area of the second electrode" that will result in a short and device becomes unusable. Since for the nanotube deposition he uses a metal solution where he puts the nanotubes as an indiscriminate mass, this effect of shorts will be a major problem dramatically affecting the yield. In our case, the nanotubes are placed or grown in a controllable way which excludes shorts.

The fact that electrons move along the dielectric surface on appreciable distance of several microns makes the Nakamoto's device very unstable. Flying electrons will charge the dielectric surface. The charging process is very dynamic, electrons go in and out of the dielectric surface, thereby causing current fluctuations adversely affecting the device

performance. In our case, the nanotube tip faces the anode electrode (claims 1-13) or is in a close proximity to it (claims 14-21) and the charging effect is excluded.
The Nakamoto's device application is aiming at a Field Emission Display (see Fig.1), and therefore he is not concerned about the reverse biased situation, when a negative voltage is applied to the anode. In his case, the nanotubes residing at the anode surface 24a (see Fig.3) will provide the emission current of practically the same amplitude as in a forward biased direction, thereby making this device unusable as a diode. However, even in the FED a good diode characteristic is important, because pixel selection in the matrix does rely on a high resistance reverse biased diode branch. In our invention, aiming at new electronic devices, the anode has a smooth surface and reverse biased, anode-to-cathode, field emission breakdown will occur at very high voltages.
Thus, our invention, although relaying on the field emission from the nanotubes as the Nakamoto's one, is distinct and unique in both device design and basic features, which result in superior cold emission diode performance.

Let us now move to your claim rejection part-35 USC –102.
With regard to claims 1, 7 and 13, there are three bulleted paragraphs on p.3.

1. Yes, we also have two electrodes laterally shifted from each other. However, one electrode is above the second one, as indicated in claims 1 and 7.
2. The first electrode 22 in the Nakamoto patent includes a conductive layer 42 and nanotube on top of it, but nanotube in our case is **"located above and protrudes into the area of a second electrode"** (claims 1, 7). If it happens in the Nakamoto structure, this will result in a short.
3. According to Nakamoto's design, layers 42 and 46 are **coplanar,** and the nanotube is **not located above the second electrode** and **should not protrude into the area of the second electrode.** In addition, in his device nanotubes are made on both layers of the structure, which is bad feature for our specific application to electronics.

With regard to claims 4-6, 8 and 19.
In col.6, line 29 Nakamoto mentions "singular-shaped fullerene", not single walled nanotube, they are physically different.
As for metal type nanotube, he discussed the possibility to fill the hollow internal portion of the nanotube with metal, as shown in Fig.5. This is completely different from metal type nanotubes claimed in our claims 5 and 6. The nanotubes by their nature happen to be three types: metallic, insulating and semiconducting. We chose the metallic one to provide a good conductance. No metal filling is needed in this case.
In claim 8 and 19, we deposit a metal layer "onto entire nanotube", which is different from filling the nanotube inside.

With regard to claims 9-10 and 20-21, Nakamoto discloses **replacement** of the carbon nanotubes with other "micro-bodies" made from the material with low work function (col.6, lines15-23). We deposit the low work function layer **"on the nanotube".** Nakamura **did not** mention Cs as the low work function layer in his list of potential candidates for the metal layer, see col.6, lines 19-23.

Claim rejection part 35 USC-103.
With regard to claims 2-3, Nakamoto disclose operation in "vacuum discharge space". As we understand, this means vacuum chamber, an obvious requirement for the electron emission device. What he did not disclose is **placement of the device into the inert gas atmosphere**, our claim 3. In his text, col.6, lines 60-61, he mentioned the method of making the fullerenes by using helium gas, which is a not related issue.

With regard to claims 14, and 16-17, the small pad of catalytic material is "less then micron and thickness of a few hundreds of nm to grow a single walled nanotube on each pad", our claim 17. In the Nakamoto's disclosure, the entire layer 48, which may or may not be a catalytic material, covers the conductive layer 46. Even if this layer happens to be Ni, there is no chance to grow a single walled nanotube, since one needs a small pad, as claimed in our claim 17.
In addition, in our case (claim 14) **"the nanotube is grown normally to the substrate plane"**, in contrast with Fig.6 of the Nakamoto's patent where the resultant Ni "pad" 48 (or 44) is turned normal to the substrate plane, thereby directing the nanotubes parallel to the substrate plane. Again, there is practically no difference between left (44) and right (48) sides of the Nakamoto's device, which makes this technology unusable for the diode fabrication.

The nanotube diameter can be less than 15 nm. However, the Ni pad diameter for the nanotube growth is significantly larger, as indicated in our claim 17.

With regards to the last bullet paragraph on p.5, "Nakamoto do not disclose the height of nanotube 48 is slightly below the plane of the first conductive layer 42" simply because in his fully lateral, coplanar approach the nanotube height, normal to the substrate plane, is unimportant for both layers 44 and 48. For him, only lateral nanotube dimension is critical.

Dear Mr. Louie, based on the above analysis we believe that our patent application has in common with the Nakamoto's patent only two things, namely, field emission mechanism of electron extraction and use of the nanotubes. None of our claims infringes on his patent and all of them are unique.
We hope our response will help you to reconsider your decision regarding our invention. If you have any questions, I would be happy to answer them. My telephone #: 631-549 5900, fax: 631 549 5974, e-m address: kastalsky@yahoo.com

Sincerely, Alex Kastalsky

Alex Kastalsky

P.S. We are sending to you a corrected version of our claim 14, where we noticed several misprints.

14. A diode comprising two electrodes laterally shifted from each other and placed on an insulating substrate; the first electrode contains the first conducting layer; the second electrode contains the second conductive layer disposed next to one of the edges of said first conductive layer on a plane below the plane of said first conductive layer; a small pad of nanotube catalytic material is deposited on said second conductive layer in close proximity to said one of the edges of said first conductive layer, and the nanotube is grown normally to the substrate plane; the nanotube height is such that the nanotube tip is slightly below or reaches the plane of said first conductive layer.